40

with and recording member;
(a)

Electron Beam Deposition of Circuits

The following arrangements have been conceived for be[am] depositing electronic circuits onto bases

Beam may also [be] X-y deflection ...

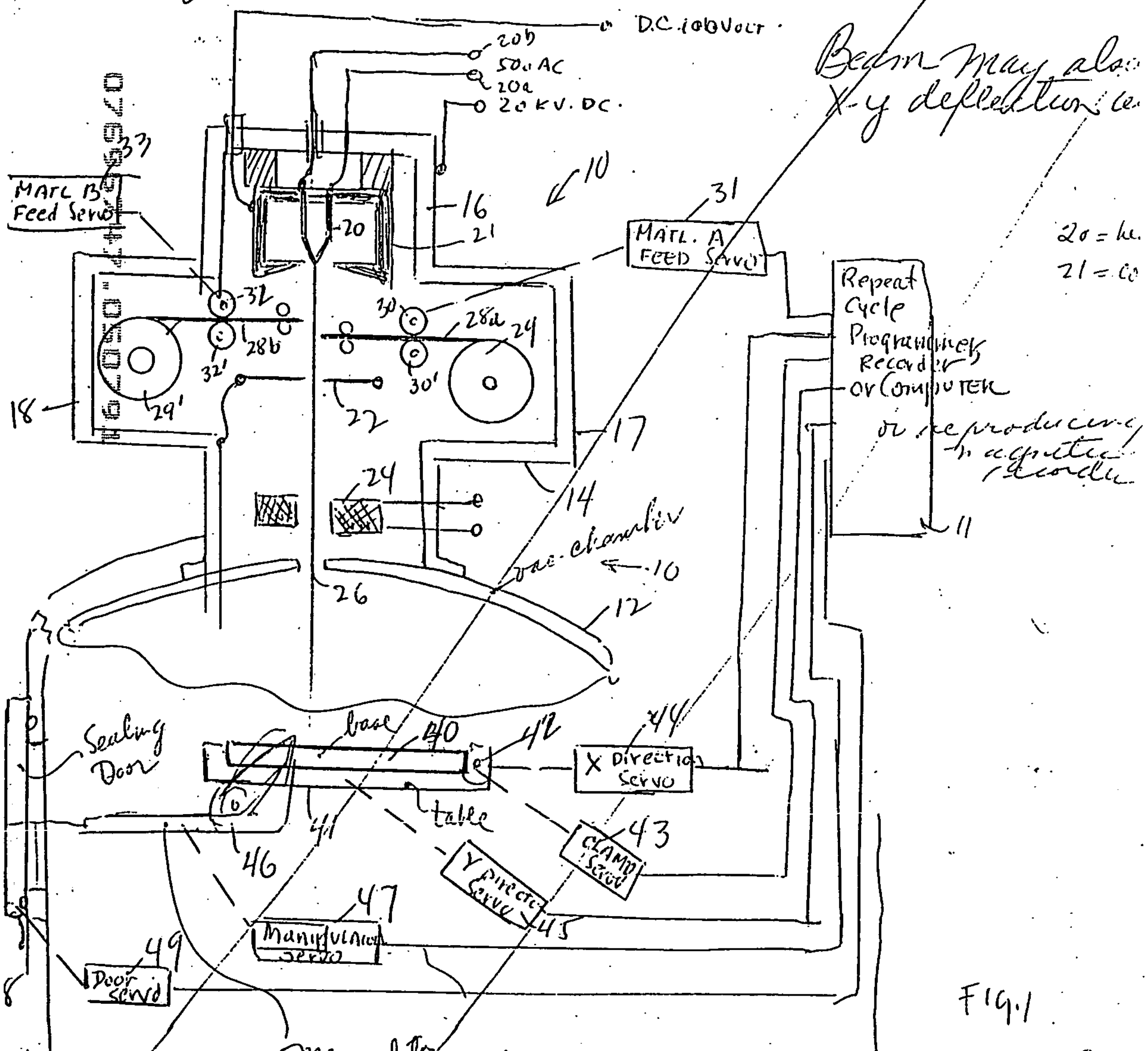

FIG. 1

Manipulator moves through door when open to place circuit board onto table 41 and/or remove it therefrom

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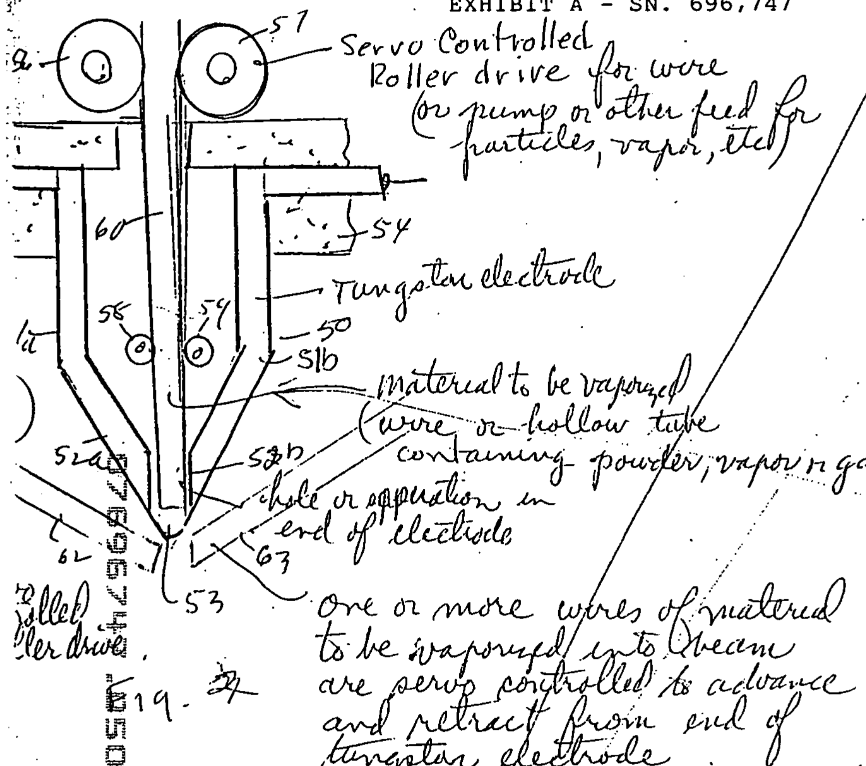
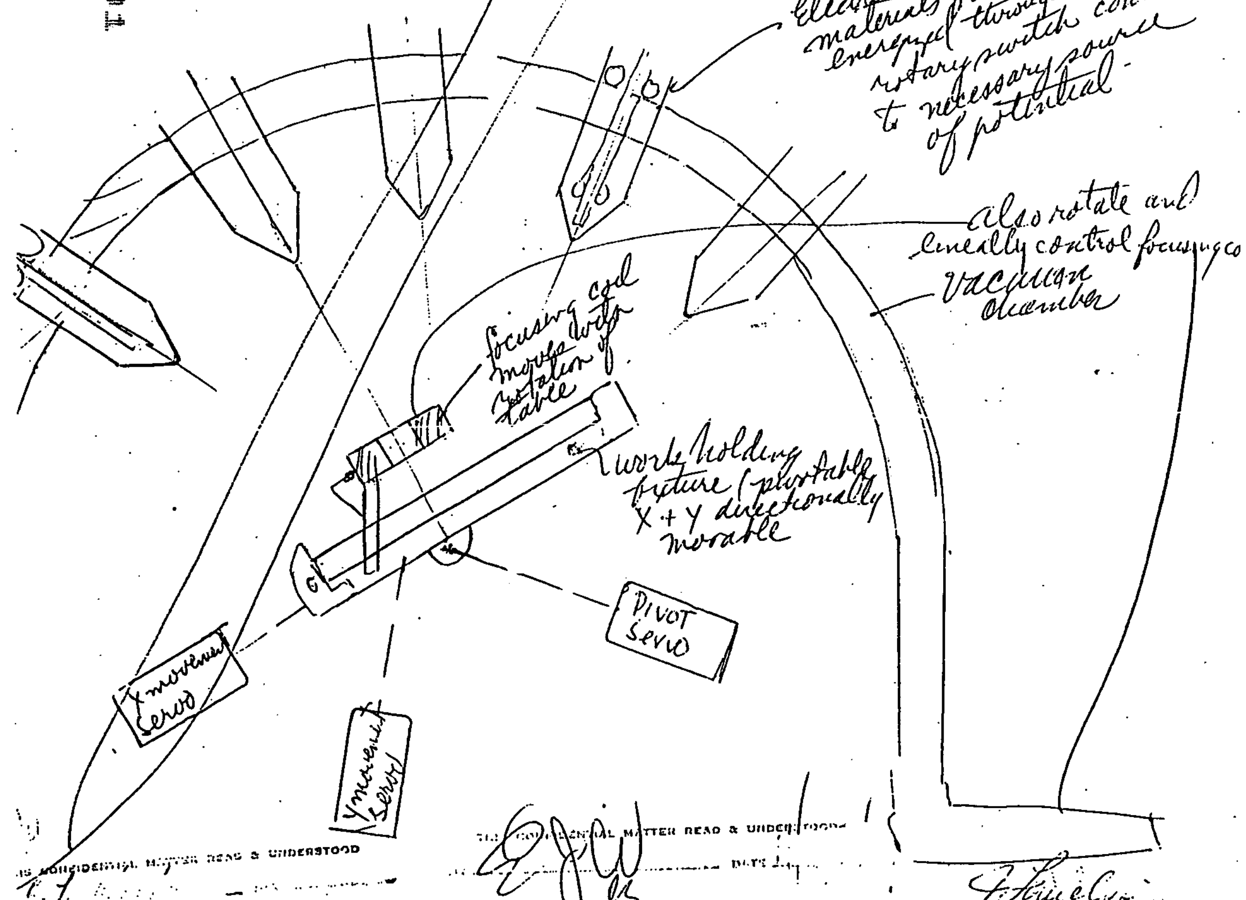

57
Servo Controlled
Roller drive for wire
(or pump or other feed for
particles, vapor, etc)
60
54
Tungsten electrode
58
59
50
51b
material to be vaporized
(wire or hollow tube
containing powder, vapor or gas molecules)
52a
52b
hole or aperation in
end of electrode
62
63
53
One or more wires of material
to be vaporized into beam
are servo controlled to advance
and retract from end of
tungsten electrode.

Fig. 3


Consumable (above structure)
Electrodes of different
materials are selectively
energized through a
rotary switch connected
to necessary source
of potential.
also rotate and
linearly control focusing co
vacuum
chamber
focusing coil
moves with
rotation of
table
work holding
fixture (pivotable
X + Y directionally
movable
PIVOT
Servo
Y movement
Servo
Y movement
Servo

12

In the electron beam apparatus of pp 140 & 141 the casing for which I have been working on over the past 10 months it is noted that:

(1) The beam may be deflection controlled by means of an analog signal or signals using deflection plates of conventional design

(2) ~~The beam focus~~ All servos such as door ~~etc~~ vac. chamber opening & closing servo, work positioning servo, ~~etc~~ servos for feeding material into the beam manipulator for admitting and removing workpieces from chamber, work clamping servo, etc as well as the means for controlling focus, deflection, and selection of (one of a multiple of) beam may be automatically controlled in an automatic cycle of operation by means of a programming means such as a magnetic or other recorder on which is recorded the necessary analog and/or digital signals to effect such control which record is operated and transduced from to derive said signals in a predetermined sequence -

(3) Material to be deposited may be admitted to beam as a rod or wire, powder, liquid, vapor or gas which materials are carried along in the beam to work piece and focused thereon by the beam energy or modulation may be controlled by a reproduced analog or digital signals to prepare (heat or erode, melt or vaporize) certain area or surface on which selected deposits are to be made

(4) Chemical reactions, alloying, doping, etc may take place in beam & by means of beam and material therein deposited on or diffused into surface intersected by beam.

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BY _____ DATE _____

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BY _____ DATE _____

[redacted]

machining or otherwise [illegible] chemically changing material deposited
eam may be effected by change of
beam energy, etc. or by means of
more auxiliary beams generated
e same gun or chamber (different guns)
are auxiliary deflector controlled and
ted.

terial to be deposited (wire, powder, vapor,
quid) may be positionally controlled by
o or zero controlled by the programming
controlling the other variable to be
[illegible] flowed or moved into the volume
focus of the beam directly above surface
ed.

am may be focused on gun into which
material is selectively fed and controlled
he programming means. After focus beam
be diverged or directed as a narrow
against surface of work and/or deflectionally
ed.

illiary beam may feed into main beam
after or at its focus or near its generation
which auxiliary beams contain atoms of
al to be deposited onto surface by
beam. Which may be deflector controlled
ter in accordance with a programmed

e optical means may be used on
ary beam generator in conjunction with
arrangements or in place of electron
generating means thereof. Maser beam
be travelled inside or parallel to electron beam
ns or may be directed at the focus
electron beam to cooperate in machining
removing preceding surface of work or evaporating
terial to be fed to beam.

[illegible] and

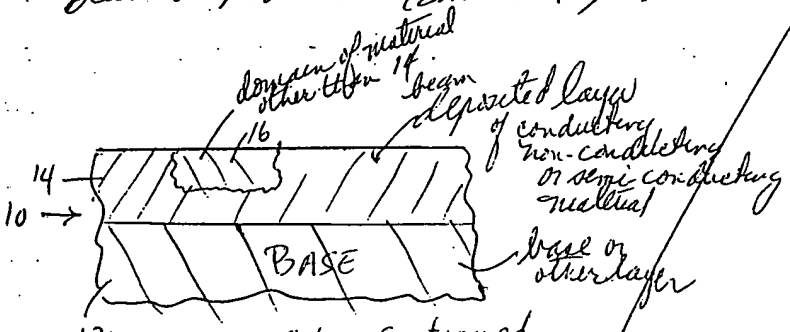
[illegible] READ & UNDERSTOOD

[illegible] DATE

[illegible] READ & UNDERSTOOD

[illegible] DATE

Beam Deposition Continued 15



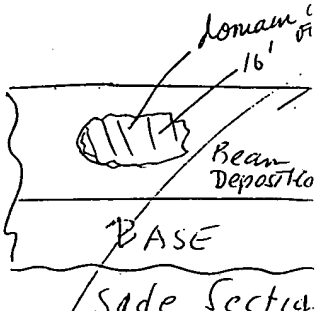
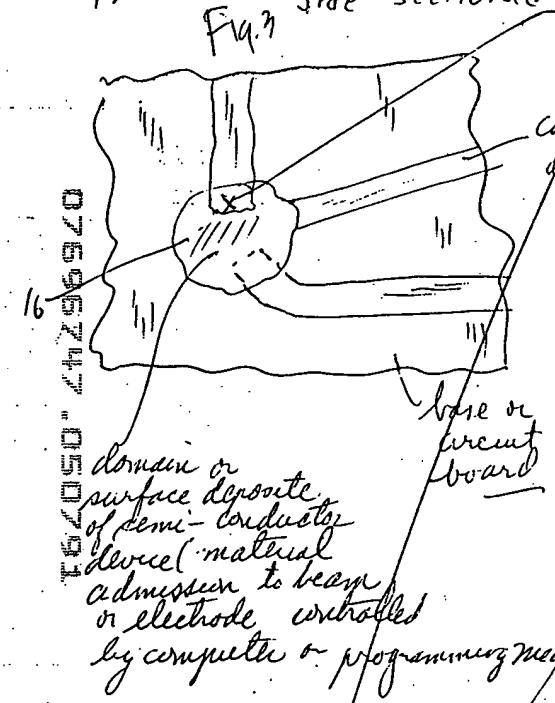


Fig. 3



All deposits are by beam controlled by analog signals reproduced from a recorder which recorders programmed signals (reproduction) also control material selection (mix unit beam, rate of flow there travel of beam across work and on-off of beam positi workpiece, handling of wo within and in and out of vacuum chambers, etc.)

Feedback signals for indicating how much ma is deposited and where to control beam position, flow and selection of ~~so~~ different materials to be admitted to beam may be effected by means a reading electron beam directed by computer or programmed (recorded signals) to scan selected area by scanning entire target as the mat is deposited or during periods when materi

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t being deposited (inspection scanning period). The
nut video signal derived by beam scanning
y be analyzed by techniques as described in
y pending application "Automatic Inspection System"
~~digitally~~ determining in digital form the
aracteristics (optical characteristics) of the material
posited.

Spectroscopy may also be employed in
ich a beam is directed against the beam deposited
a and causes an emission of electrons therefrom
ich is spectrally analyzed, the results of
hich are used to control further deposition
removal of deposited material.

Eric J. Waldmeyer

Material from p. 138 to this point read by Isidore Match on

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Classification of Electron Beam Deposition apparatus
d Methods.

The following are arrangements, apparatus and methods I
e conceived relating to electron beam manufacture of micro-
ature circuits which I intend to incorporate in a number of
nt applications.

Deflection and intensity control of deposition (or machining, welding)
electron beam or beams attained by one of the following techniques:
a) Reproduced magnetically recorded video picture signal or signals.
(b) video signal generated by scanning optical recording
(c) output of digital recorder
(d) output of comparator (summing amplifier) fed (a) or (b) above
plus feedback signal generated by scanning either or both
beam containing deposition material or surface containing
posited material.*

Correction for over or incorrect area deposition may be made
controlling beam per-se (by computer command signals or
tput of summing amplifier being fed command reproduced video
gnal and feedback scanning signal) which beam either

machines or vaporizes material already deposited.**
** Vaporized material (vaporized by corrective beam) may
removed from surface of workpiece by another beam
deflection controlled or otherwise positioned to effect said
removal.

Correction for over deposition may also be made
deflection controlled beam containing an oxidizing or other
for chemically changing part of deposited material to an
compound.

Work may be positionally controlled by command sig
derived from command recording as described or compa
recovery command and feedback signals as described

II Deflection control of beam (X, Y position plus
intensity modulation plus position of focus (Z contr
depending on position of the surface being beam-deposited on
(a) depositing semi-conductor, metal or dielectric mate
(b) depositing plural materials simultaneously differen
(c) " " " at different times by differen
(d) introducing different materials at same or different ti
single feeder
(e) welding, machining, vaporizing deposited material (

III Feedback signal compared with reference command (repr
(beam control signal) is generated by:
(a) Beam scanning and analysis of ionized or reposed parti
therein as beam is generated and monitored(s) admitted there
(b) Optical beam or work scan plus analysis
(c) Spectroscopy or spectrographic (automatic) analysis
mass spectrograph + scan.
(d) Electron beam scan of deposited work with a relat
read beam

IV Material feed (to beam) by and as:
(a) Rod or wire, servo driven into beam, into, beam focus, to
intermediary
electrode generating beam (into orbit between electrodes) or directly into
of beam at work; servo controlled by direct command or com
output recovery reproduced command signal plus feedback signal.
(b) servo controlled powder feed (as above)
(c) servo valve controlled (as above) feed of liquid conta

tion material into beam (or vaporized deposition
rial into beam).

Plural Beams

Plural reproduced deflection control signals plus
ural control or reference signals, plus work positioning
als (optional), plus focus adjustment signals (optional)
others mentioned above are used to simultaneously
quentially control beams each depositing different material
aterials

Beam Deposition Techniques (Miscellaneous features)

(a) Electron beam plus photographic techniques.

(1) Beam deposits components onto conducting film pattern
formed by photo-etching; photocomposition (exposure to light
and developing)

(2) Optical beam (laser light beam) is deflection controlled
and cooperates with deflection controlled electron beam
in welding, machining, effecting deposition, chemically
reacting (on dep material(s)) deposited by electron beam, etc
Laser light beam may also be used to carve photographic
film, expose it per se, develope image, used for corrective
purposes (vaporize or machine material (film) deposited
by electron beam, vaporize material(s) to be
deposited or directed by electron beam, weld work, etc.
Laser beam deflection controlled by servo controlled
mirror(s) controlled by reproduced command signal
or output of comparator or computer -

(b) Plural beams cooperate. One vaporizes (laser or electron
am) material to be deposited, feeds it at or to second deposition
n, which is deflection controlled and deposits material,
d beam scans either second beam or surface which
s just received material to provide a feedback signal
a comparator (summing amplifier or other) which
vides an output to control both first and second
eams (i.e. on-off or intensity or focus of first beam
d position of second beam) (c) First and second beams
e controlled by respective command signals fed to

48 well by passing beam thru mask

respective comparator means each of which receives
sance feedback signal generated by timed beam
scanning what is being or was just deposited

(c) An apparatus for repairing, modifying or adding
micro-miniature circuits has also been conceived based on
beam scanning the circuit already deposited (surface scanning)
and determining by reading with the beam the physical-optica
or atomic structure of the circuit, by x-ray scanning, by opti
scanning said circuit (with a modulated light beam) or by
a combination of two or three of these scanning techniques,
been conceived. The output signal derived by scanning is
fed to a computer which thereafter provides signals for
controlling beam deflection, modulation, position of workpiece, material
selection and feed to beam, mask selection, etc to effect
desired repair, change in structure, etc

(d) Vaporization of material in a primary electron be
or by means of a matter through which beam(s) the deposito
beam is passed and picks up the material to be deposited, carries
(e) Material changed by, new composition(s) formed in
a beam directed against a workpiece by either the action
of the beam per se or the reaction of the beam (temperature, e
said two or more of the materials admitted thereto or one o
more admitted material and material of the workpiece.

(f) Growth of predetermined crystal structure by means of fe
melting material(s) admitted thereto and deposited, or by
a combination of materials admitted to beam being deposi
thereby onto a crystal being grown. Programmed control o
beam deflection, on-off modulation, focus; crystal movem
material flow into beam (based on feedback derived by sca
beam, crystal, etc (as described above) fed into comparator also
command signal and providing difference signal for contro
(g) Creation of mask through which erosion electron bea
is directed for chemically and/or mechanically affecting (e
changing chemically, cracking, etc) the workpiece by means of
photosensitive mask material, thermoplastic recording film (
of General Electric Co. which mask is formed by exposure to a work
beam of said mask material which writing beam is mod
to affect the desired image (transparent and opaque or re
pattern in the mask. Mask may is in the field of the

EXHIBIT A - SN: 07/696,747

:ted against the workpiece (in path of beam)
(b) Use of a unique mask in beam path made of a grating
- as a diffracting grating produced by beam etching thin plate
selective and controlled deposition of material introduced in beam
or to or after passing thru mask. Plural diffraction gratings
:ed at right angles to each other will produce line beams
s than .001 inches in diameter.
(c) Use of a mask to break up beam into one electron or mass
m into a plurality of beams directed thereafter against
lected areas of the workpiece for effecting welding,
achining (hole drilling), erosion or deposition onto said select
.
(f) Program control (plus feedback where necessary) of beam
tion (deflection), focus, etc. & position of workpiece, and
fferent material fed into beam to selectively deposit
ferent material onto different areas of workpiece
g) Exposure, machining, chemically changing, development and
ng of a photosensitive material to form a circuit by means
dam and use of beam to deposit semi-conducting, dielectric
onducting materials onto selected areas of photosensitively develope
cuit all by automatic control as above.

J. Mullen

C.1

PAGE 150 - IS MISSING

Extrude multiple sheets or strips apart + filaments of different materials) + laminate continuously.

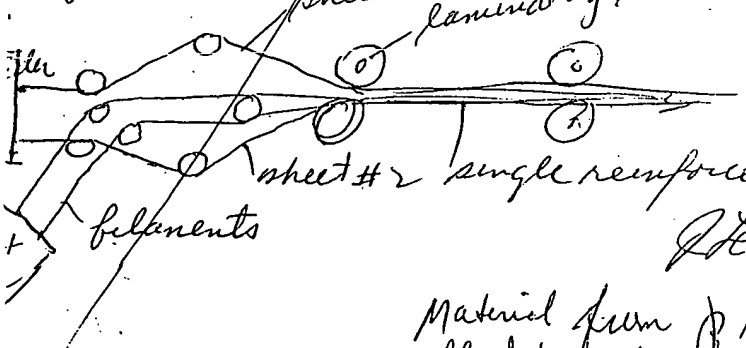
to rods, tubes, wires or other structural members made of plastic filaments or metal whiskers (single crystals of metal of exceptional strength) which are compacted together and bonded or welded where they cross. They may be encapsulated in another plastic, metal sintered powdered metal, etc to form solid, filament reinforced structures.

It is conceived to simultaneously extrude a plurality of sheets of thermoplastic or ribbons thereof from a single die cut from spaced-apart slit openings and guide said sheets or strips as follows:

(a) First guide apart continuously adjunct filaments (reinforcing or decorative), or cloth, threads or other material as a continuous or broken web between two of said strips and continuously laminate into a single, integral sheet of reenforced material.

(b) Draw each sheet thru polishing rolls and then laminate (improved clarity).

(c) Simultaneously extrude from another extrusion chamber, a plurality of reinforcing filaments (of glass, polypropylene, or other plastic), guide these between at least two of the strips, or ribbons or sheets not extruded and continuously laminate together by



J Emerson

Material from p 145 to this point read + understood by me this 4th day of Jan 1965
J Serlin

61'